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DESCRIPTIONS OF THE IMMATURE STAGES OF *MYNDUS CRUDUS* (HOMOPTERA: FULGOROIDEA: CIXIIDAE)[1]

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Abstract.—The 5 immature stages of *Myndus crudus* Van Duzee, an apparent vector of lethal yellowing disease of palms, are described and illustrated and a key for separating nymphal instars is provided. Features useful in distinguishing nymphal instars include the number of metatarsal segments (2 in first through third instars, 3 in fourth and fifth instars), the presence of a tooth on the profemora of fourth and fifth instars, and the increase in body size, wingpad size, and number of pits during nymphal development.

Myndus crudus Van Duzee has been recorded from Florida south to Venezuela and west to Panama, central Mexico, and the southern tip of Baja California (Kramer 1979). This planthopper has been implicated as a vector of lethal yellowing disease of coconut palms (*Cocos nucifera* L.) (Howard and Thomas 1980; Tsai 1980; Tsai and Thomas 1981).

The eggs of *M. crudus* are laid in moist soil adjacent to grass stolons or palm roots. The nymphs feed at the stem bases and roots of several species of grasses, sedges, and palms (Reinert 1977; Tsai et al. 1976; Tsai and Kirsch 1978). Both adults and nymphs are phloem feeders on coconut palm (Fisher and Tsai 1978). At least nine species of palms as well as several species of grasses are feeding hosts of *M. crudus* (Reinert 1977; Tsai 1978). Although *M. crudus* has been studied extensively in the laboratory and field (Reinert 1977, 1980; Tsai and Kirsch 1978), including laboratory rearing (Tsai et al. 1976; Tsai and Kirsch 1978), the eggs and nymphs of this species have not been illustrated or described. Tsai and Kirsch (1978) provided measurements of the eggs and nymphs but not detailed descriptions. Zenner and Lopez (1977) published measurements and figures of eggs and nymphs of *Haplaxius pallidus* Caldwell, a synonym of *M. crudus* (Kramer 1979).

There are few available descriptions of the immatures of any Cixiidae and none of any species of *Myndus*. Cumber (1952) described the immatures of *Oliarus atkinsoni* Myers, and Myers (1929) described the third, fourth, and fifth instars of *Mnemosyne cubana* Stål and the fifth instar of *Bothriocera*

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signoreti Stål. The fifth instar of *Oliarus placitus* Van Duzee is being described by Wilson (unpublished).

This paper includes descriptions of, and keys for separating, the five immature stages of *M. crudus*.

Materials and Methods

Specimens to be described were obtained from laboratory stock maintained by Tsai, and preserved in 70% ethyl alcohol. The description of each stage is based on 10 specimens. The first instar is described in detail, but only major changes from previous instars are described for subsequent instars. Comparative statements refer to previous instars (e.g., "darker"). Dimensions of eggs and nymphs are expressed in mm as mean ± SE. For nymphs, length was measured from tip of vertex to tip of abdomen; width was measured across the widest part of the body, usually the mesothoracic segment. Thoracic length was measured along the midline from the anterior margin of the pronotum to the posterior margin of the metanotum; this measurement was included because total length measurements are affected by differences in head shape among specimens, and because the abdomen often becomes distended when preserved in ethyl alcohol. Specimens of each instar were cleared in 10% KOH in order to observe some structures (e.g., tergite of first abdominal segment).

Descriptions of Immature Stages

Egg (Fig. 1).—Length 0.54 ± 0.032; width 0.17 ± 0.030.

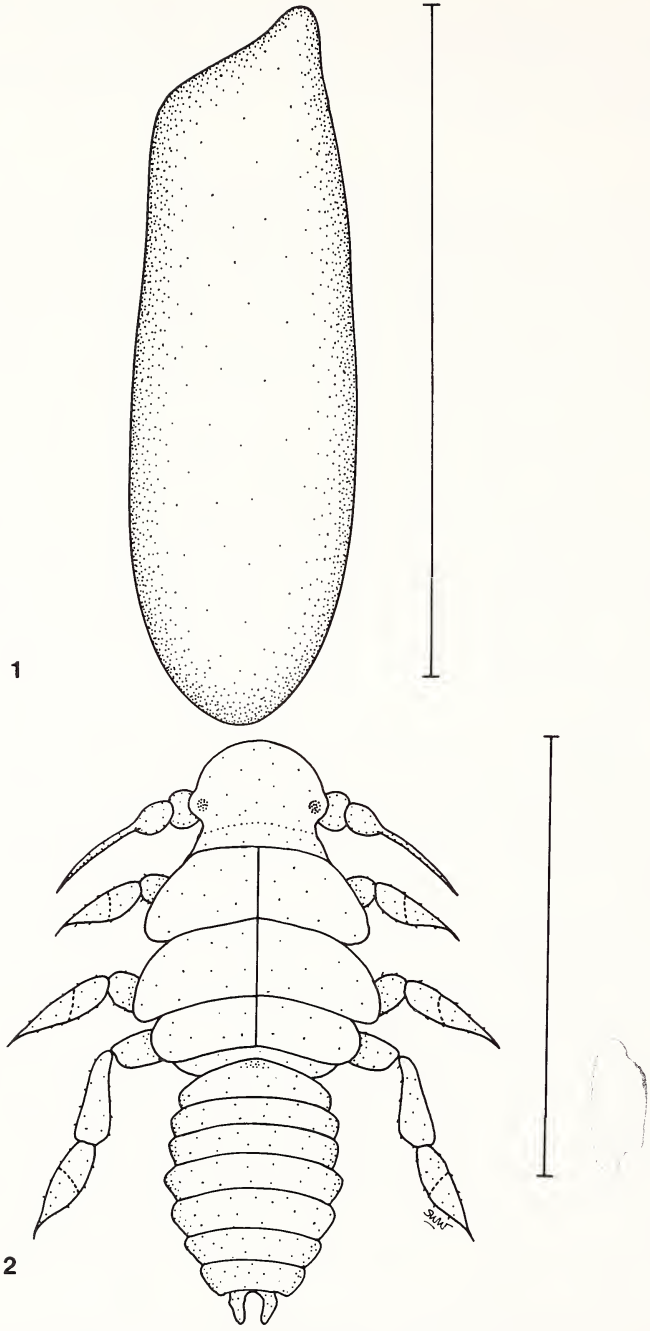
Eggs laid singly; elongate, subcylindrical; white; chorion translucent, smooth; anterior end asymmetrical and pointed, posterior end broadly rounded.

First Instar (Fig. 2).—Length 0.64 ± 0.088; thoracic length 0.24 ± 0.041; width 0.26 ± 0.041.

Form elongate, subcylindrical, slightly flattened dorsoventrally, widest along mesothorax. Vertex, frons, thoracic nota, and abdominal tergites with a few, shallow, indistinct pits.

Vertex broadly rounded anteriorly, widest in anterior ½, slightly narrowing posteriorly. Frons subquadrate, lateral margins slightly convex, dorsal margin highly convex, juncture with clypeus obscure. Clypeus narrowing distally. Beak 3-segmented, extending just beyond metacoxae; segment 1 obscured by clypeus, segments 2 and 3 subequal. Eyes reduced, barely visible in ventral view, red. Antennae 3-segmented; scape and pedicel cylindrical and subequal; flagellum bulbous basally, filamentous distally, bulbous portion subequal in size to pedicel.

Thoracic nota divided by a longitudinal mid-dorsal line into 3 pairs of plates. Pronotum longest medially; each plate subrectangular, anterior mar-



Figs. 1, 2. Immature stages of *M. crudus*. (1) Egg, (2) 1st Instar. Vertical bar = 0.5 mm.

gin almost straight to ca. level of lateral margin of eye then extending posterolaterally, lateral margin slightly convex, posterior margin slightly sinuate. Mesonotum with median length subequal to that of pronotum; each plate subrectangular, lateral margin convex, posterior margin broadly curved. Metanotum with median length ca. ⅔ that of mesonotum; each plate subrectangular, lateral margin convex. Pro- and mesocoxae posteromedially directed; metacoxae smaller, obscured by trochanters. Tarsi 2-segmented, divisions between segments very obscure; segment 1 somewhat wedge-shaped; segment 2 subconical, slightly curved, with a pair of slender apical claws.

Abdomen 9-segmented, subcylindrical, widest across segments 2 and 3; segment 9 elongate vertically, surrounding anus.

Second Instar (Fig. 3).—Length 1.01 ± 0.103; thoracic length 0.40 ± 0.054; width 0.40 ± 0.052.

Antennae with bulbous portion of flagellum ca. ⅔ length of pedicel.

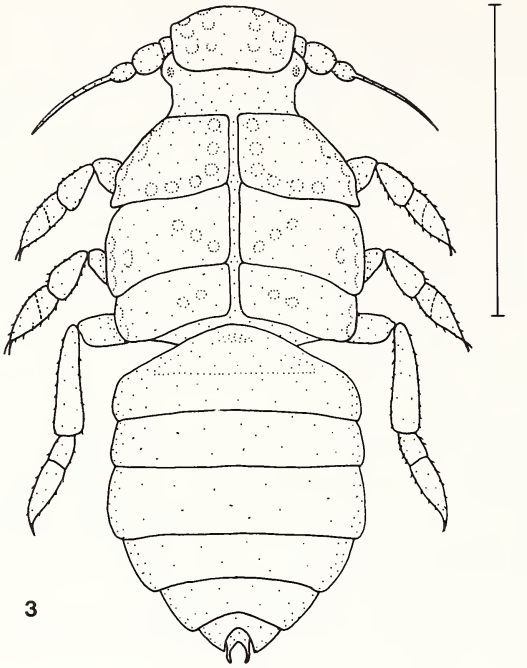
Pronotum with each plate bearing 10–15 shallow pits. Each plate of mesonotum bearing ca. 7 pits with 3 pits extending anterolaterally from posteromedial corner and 4 pits near lateral margin; posterolateral corners of plate slightly lobate. Each plate of metanotum bearing ca. 4 pits with 2 pits near medial border and 2 pits near lateral margin.

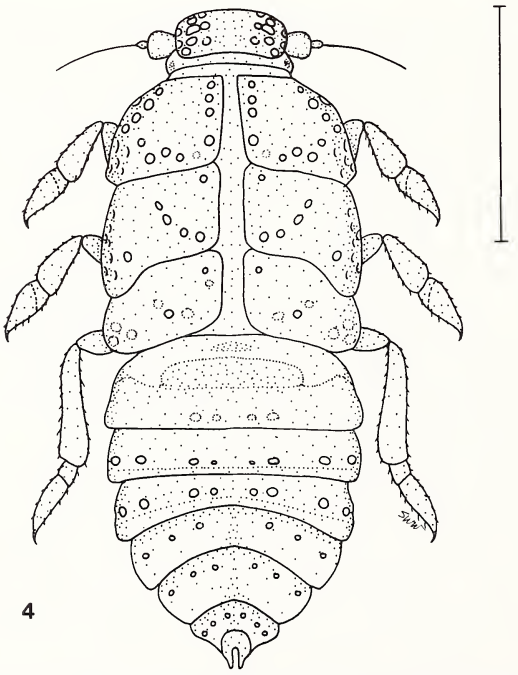
Third Instar (Fig. 4).—Length 1.29 ± 0.104; thoracic length 0.51 ± 0.048; width 0.55 ± 0.073.

Vertex somewhat less rounded anteriorly; pits in 2 irregular rows, more distinct; posterior and lateral margins distinct, slightly carinate, and sinuate. Frons with 2 irregular rows of pits bordering lateral margins; lateral margins almost straight, narrowing distally, juncture with clypeus distinct, ventral margin concave; juncture between anterodorsal postclypeus and posteroventral anteclypeus straight and apparent laterally. Antennae with bulbous portion of flagellum ca. ½ length of pedicel.

Pronotum with each plate bearing ca. 20 large, distinct pits. Each plate of mesonotum bearing 12–13 large, distinct pits with 1 pit in the anteromedial corner, an oblique row of 3–4 pits (usually 4) extending anterolaterally from posteromedial corner, 7–8 pits near lateral margin; posterior margin distinctly lobate in lateral ½. Each plate of metanotum bearing 7–8 pits with 1–2 pits near medial border, 2–3 pits ca. midway between medial and lateral margins and 2–3 pits near lateral margin.

Abdominal tergites of segments 1 and 2 reduced, not extending to lateral margins. The following number of pits on either side of midline of each segment: segment 3 with 2 pits on tergite, segments 4–5 each with 5 pits on tergite, segment 9 with 3 caudal pits. Tergites 6–8 each with a pair of enlarged subtriangular, dorsoposteriorly oriented waxpads in intermembranous area posterior to narrow tergite (waxpads probably present but indistinct in previous instars); each waxpad with a transverse row of 3 very small, obscure pits near anterodorsal margin.





Figs. 3, 4. Immature stages of *M. crudus*. (3) 2nd Instar, (4) 3rd Instar. Vertical bar = 0.5 mm.

Fourth Instar (Fig. 5).—Length 2.20 ± 0.162; thoracic length 0.81 ± 0.068; width 0.92 ± 0.074.

Vertex, frons, thoracic nota, and abdominal tergite light gray-brown; pits, intermembranous areas, clypeus, beak, antennae, legs, and sternum white.

Head with pits on vertex and frons more numerous. Antennae with scape reduced, ca. ⅓ length of pedicel, bulbous portion of flagellum ca. ⅓ length of pedicel.

Pronotum with each plate bearing 25–30 pits. Each plate of mesonotum bearing 22–24 pits with 1–2 pits in anteromedial corner, an oblique row of 5 pits extending anterolaterally from near posteromedial corner, and 13–15 pits near lateral margin and extending onto wingpad; each wingpad covering ca. ⅔–¾ of each metanotal plate laterally. Each plate of metanotum bearing 9–13 pits in the following arrangement: 3 pits near anteromedial border, 3–4 pits ca. midway between medial and lateral margins and 3–6 pits near lateral margin. Distal ⅔ of profemora with slender tooth on median aspect of ventral margin. Metatibiae with setae in longitudinal rows on ventral aspect (present in previous instars but not apparent); distal setae somewhat stout, almost toothlike or spinelike. Metatarsi 3-segmented, segments 1 and 2 cylindrical, segment 3 subconical, slightly curved and bearing a pair of slender apical claws; segment 3 slightly longer than segment 1, segment 2 ca. ⅔ length of segment 1.

Abdomen with each segment bearing the following number of pits on either side of midline: segment 2 with 1 pit on tergite near midline (obscure, not illustrated), segment 3 with 2 pits on tergite near midline and 1 pit near lateral margin, segments 4–5 each with a transverse row of 7 pits extending from near midline to lateral margin, segments 6–8 each with 2 pits on tergite near lateral margin, segment 9 with 4 caudal pits. Waxpads on segments 6–8 each with a transverse row of 4 very small pits near anterodorsal margin.

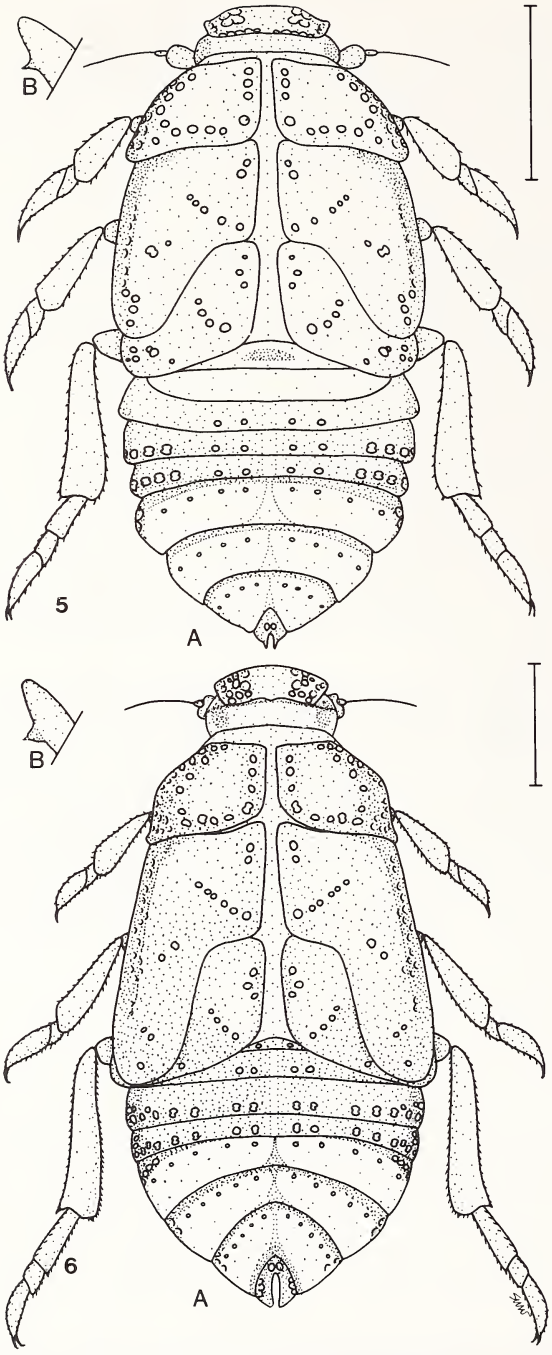
Fifth Instar (Fig. 6).—Length 2.68 ± 0.122; thoracic length 1.17 ± 0.059; width 1.31 ± 0.077.

Sclerotized portions of body darker.

Head with pits more numerous on vertex and frons.

Each pronotal plate bearing 31–33 pits. Mesonotal plates bearing 25–29 pits with 2 pits in anteromedial corner, an oblique row of 6 pits extending anterolaterally from near posteromedial corner, 17–21 pits on wingpad and near lateral margin of plate; wingpads extending to or beyond apex of metanotal wingpad. Each metanotal plate bearing 8 pits with 3 pits in anteromedial corner, an oblique row of 4 pits extending anterolaterally from near posteromedial margin, and 1 pit near region overlapped by mesonotal wingpad; wingpads extending almost to fourth tergite. Profemora with stouter ventral tooth.

Each abdominal segment bearing the following number of pits on either side of midline: segment 2 with 1 pit on tergite near midline; segment 3 with



Figs. 5, 6. Immature stages of *M. crudus*. A. Nymph, B. Distal end of profemur. (5) 4th Instar, (6) 5th Instar. Vertical bar = 0.5 mm.

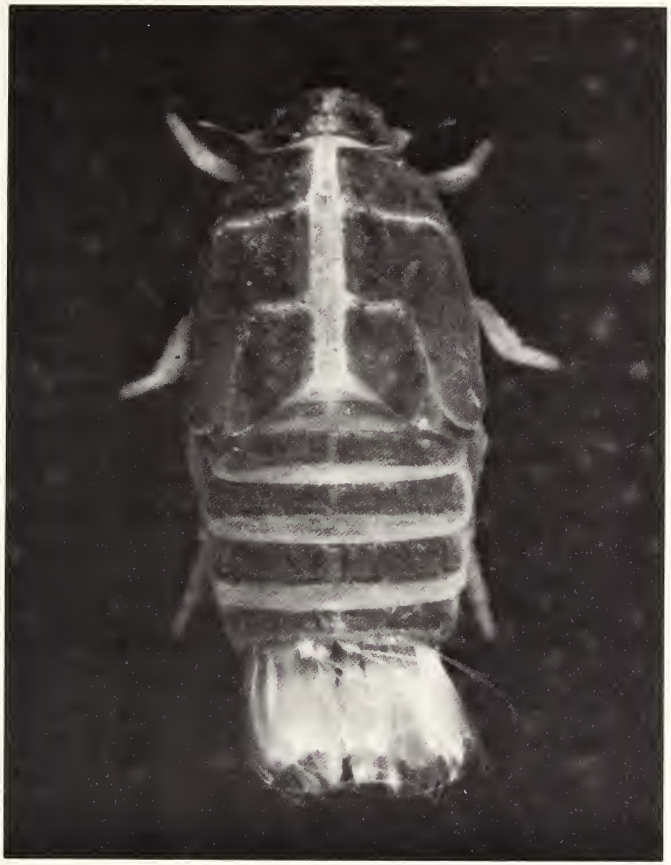


Fig. 7. *M. crudus* nymph with waxy exudate.

2 pits on tergite near midline (lateral pit present in previous instar absent in this instar); segment 4 with a transverse row of 10–11 pits on tergite; segment 5 with a transverse row of 10 pits on tergite; segment 6 with 4 pits on tergite laterally, segments 7–8 each with 2 pits on tergite laterally, segment 9 with 4 caudal pits. Waxpads on segments 6–8 each with a transverse row of 5 very small pits near anterodorsal margin. Waxy exudate present in this and earlier instars in living specimens (Fig. 7).

Key to the Nymphal Instars of *M. crudus*

1. Metatarsi 2-segmented; profemora lacking tooth on ventral margin (Figs. 2–4) 2
– Metatarsi 3-segmented; profemora bearing tooth on ventral margin (Figs. 5, 6) 4

2. Posterolateral corners of mesonotum distinctly lobate; mesonotum with more than 10 distinct pits on each side (Fig. 4) Third Instar
– Posterolateral corners of mesonotum not lobate or weakly so; mesonotum with fewer than 10 pits on each side, pits shallow and often indistinct (Figs. 2, 3) 3
3. Mesonotum with ca. 7 indistinct pits on each side; basal bulbous portion of antennal flagellum distinctly smaller than pedicel; thoracic length greater than 0.35 mm (Fig. 3) Second Instar
– Mesonotum apparently lacking pits; basal bulbous portion of antennal flagellum subequal to pedicel; thoracic length less than 0.30 mm (Fig. 2) First Instar
4. Mesonotal wingpads extending to apex of metanotal wingpads; mesonotum with an oblique row of 6 pits on each side extending anterolaterally from near posteromedial corner (Fig. 6) Fifth Instar
– Mesonotal wingpads not extending to apex of metanotal wingpads; mesonotum with an oblique row of 5 pits on each side extending anterolaterally from near posteromedial corner (Fig. 5) Fourth Instar

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